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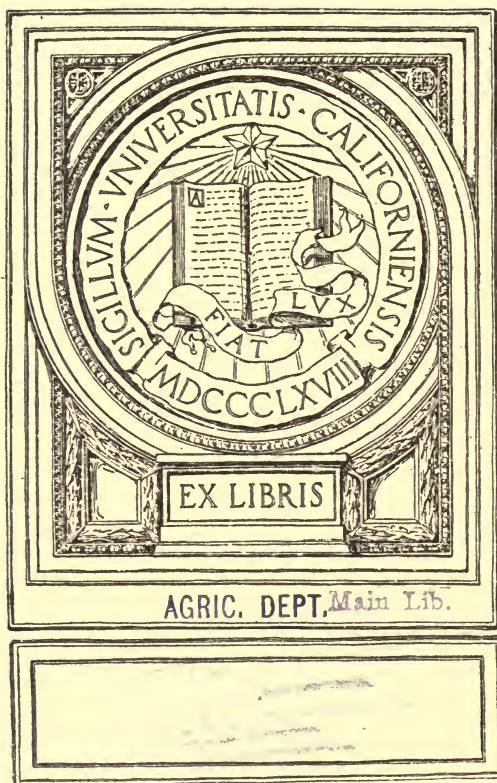


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THE
CAROB-TREE
BY
F. GENNADIUS
1902

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THE CAROB-TREE

BY

P. GENNADIUS

Director of Agriculture,

Cyprus.

1902.

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Panagiōtēs G. Gennadios

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*Director of Agriculture,
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TO WHOM
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THE CAROB-TREE.

(CERATONIA SILIQUA)

MANY are of opinion that the *Lotus* of the *Lotophagi*, mentioned by the ancient Greeks, was the Carob-tree; this opinion however, as will be shown further on, cannot be supported. The ancient Greeks used the term *Lotus* for various kinds of plants.

Besides the *Lotus* of the *Lotophagi* ⁽¹⁾ Homer mentions a *Lotus* ⁽²⁾ which is, without doubt, an annual plant. Herodotus also mentions two kinds of *Lotus*, the *Krineon*, which was called by the Egyptians, as he says, *Lotus* ⁽³⁾, and the *Lotus* of the *Lotophagi*, which bore a sweet, edible fruit, used in making a kind of wine, its shape being round like that of the *Pistacia Lentiscus* ⁽⁴⁾.

Theophrastus, who is the first author who makes mention of the Carob-tree, describes, in more or less detail, four *Lotuses*, viz: the *Lotus-tree* ⁽⁵⁾, the *Herbaceous Lotus* ⁽⁶⁾, the *Egyptian water Lotus* ⁽⁷⁾ and the *Lotus* of the *Lotophagi* ⁽⁸⁾.

This last *Lotus* is described by Theophrastus as being a large, black-wooded tree, similar in size to the pear-tree, or perhaps somewhat smaller, with serrate leaves, resembling those of the *Quercus coccifera*, and with fruit of the size of a bean, which grows thickly on the shoots and, when ripe, changes colour like the grape.

Theophrastus also adds that there were many varieties of this *Lotus*, the variation consisting in the fruit, and that one of these varieties bore fruit without kernel.

Without seeking to define the trees which Theophrastus mentions in this passage as *Lotuses*, one may assert, judging not only from the descriptions he gives, but especially because the Carob-tree is distinctly mentioned and clearly described by him in another passage ⁽⁹⁾, that he does not allude to this tree.

Dioscorides, who also knew the Carob-tree, as appears from the references he makes to some peculiarities of its fruit ⁽¹⁰⁾, mentions five

⁽¹⁾ Odyssey I, 94,

⁽²⁾ Odyssey Δ, 604.

⁽³⁾ 2, 92.

⁽⁴⁾ 4, 177.

⁽⁵⁾ On causes of plants, 4, 6, 9, etc.

⁽⁶⁾ On history of plants, 7, 8, 3, etc.

⁽⁷⁾ " " 4, 8, 9, etc.

⁽⁸⁾ " " 4, 3, 1.

⁽⁹⁾ " " 4, 2, 4,

⁽¹⁰⁾ De Materia medica, A, 158.

Lotuses: that is to say, the *cultivated*, the *wild* and the *large Lotus* which, as appears from the descriptions, were herbaceous plants; the *Egyptian* (mentioned and described also by Herodotus and Theophrastus), which certainly is the *Nymphaea Lotus* of the Nile, and lastly the *Tree-Lotus*, the fruit of which, he says, is larger than a grain of pepper, sweet, eatable and wholesome ⁽¹⁾.

The *Lotus* of the *Lotophagi* is more fully and more clearly described by Polybius in a passage cited in Athenæus ⁽²⁾:—

“This *Lotus*, Polybius says, is a thorny shrub, bearing leaves resembling those of the *Rhamnus* and a fruit tasting like the date or fig, of a red colour, with a shape like that of a round olive and with a small and hard kernel.” He also states that in his times use of this fruit was made on the coasts of Libya, where a kind of flour was made from it as also a kind of wine, which would only keep for ten days.

From this description of Polybius there remains no doubt that at least one kind of the renowned *Lotus* of the *Lotophagi* is the thorny shrub *Zizyphus Lotus*, which even now is to be found in abundance on the northern shores of Africa, as well as in Cyprus. The fruit of this shrub is called by the Arabs “Seedra” and is used, as in ancient times, for making a kind of bread and a refreshing beverage, which keeps for a few days only. In Cyprus this shrub is called “Paloura” and its fruit “Konaron” and is sometimes eaten as a sweetmeat.

Some of the kinds of the *Lotus* which Theophrastus mentions were in every probability species of *Crataegus* and *Zizyphus* which grow in large numbers at the present time also on the northern shores of Africa.

The Carob-tree at the time of Theophrastus grew in Syria, Ionia, Rhodes and round Knidos. The inhabitants of Ionia called it *Xeronia*, and others *Egyptian fig-tree*. This appellation was, however, an erroneous one as this tree did not then grow in Egypt ⁽³⁾.

It appears however that the Carob-tree must have grown at that time on the coasts of Africa to the west of Egypt and especially in Tripoli and Kyrenæa, where even at the present time it grows spontaneously. Carobs from these places were probably transported to Egypt, from whence the Greeks, who had dealings with that country, purchased them and hence called them *Egyptian figs*.

However, this is certain, that the tree is indigenous in Syria and probably also in the northern coasts of Africa. From these countries it has spread and has been acclimatized in certain parts of Asia Minor, in Greece, in the Greek Islands and in southern Italy.

The Carob-tree was certainly introduced into Italy first by the Greeks, as is proved from the names the Romans used both for the tree and its fruit, having called the Carob-tree *Ceratonia* and its fruit *Siliqua græca* (hence the *Siliqua dulcis* of apothecaries).

⁽¹⁾ De Materia Medica, A., 171,

⁽²⁾ 14, page 65.

⁽³⁾ Theophrastus: On the History of Plants, 4, 2, 4.

Before the Christian era, the Carob-tree does not seem to have spread in the main Greek islands for Theophrastus makes no mention that it was to be met with in Cyprus and Crete, where it is now very common and grows spontaneously (*). But even later the Carob-tree does not appear to have grown in Greece, as, Galenus, condemning the indigestibility of carobs, hoped that they would not be transported to Greece from the places where they were produced.

At the time of Christ, according to the evidence of Theophylactus (1), this tree was very common both in Syria and Judea. Carobs were, at that time, used for feeding cattle and especially pigs, and were considered as being a very inferior food for man, as is proved by the parable of the prodigal son, according to which he "would fain have filled his belly with the husks that the swine did eat: and no man gave unto him (2)."

From then, and for some centuries after Christ, this tree was known to the Greeks by the names *Keronia* or *Keratea*. Later on besides these names the following names were also used and remain in use up to now: *Teratsia*, *Xylokeratea*, *Kountouroudia*, *Koutsoupia* and *Charoupia* (and the fruit: *Teratsi*, *xylokeraton* (**), *kountouroudi* and *charoupi*).

This last name (*Charoupia*) is of Arabic origin (Kharrub) and the same root of the word is common all over Europe. This is attributed to the fact that the Arabs, who, during the middle ages, reigned over the Mediterranean encouraged or introduced the cultivation of the Carob-tree and the use of its fruit throughout the southern European countries.

Thus the tree is called now in English the *Carob-tree* (and Locust-tree) and the fruit *carob* (and locust bean), in French *Caroubier* and the fruit *caroube* or *carouge*, in Italian the tree *Caroba* or *Carruba* and the fruit *carrubio* or *carobo*. The Spaniards call the carob *Algaroba* and the Germans *Caruba*.

In some parts of Europe the Carob-tree is also called "Saint John's-bread-tree" (in French "arbre à pain de St. Jean," in German "Joannis-brodbaum.") This appellation appears to be the result of a wrong interpretation or tradition, according to which the *locusts*, which St. John the Baptist ate in the desert with honey (as mentioned by St. Matthew ³ and St. Mark ⁴) were carobs (†).

* The great number of the wild Carob-trees to be met with in several districts in Cyprus may be attributed to the distribution of the species by animals and especially by cattle. These animals are extremely fond of carobs; and when they eat them the seeds are neither broken nor do they undergo in the course of digestion any alteration which can destroy the germinating power of the seeds, which are rejected with the excreta.

(1) Geoponica of Basso, 10, 72, note.

(2) The Gospel according to St. Luke. 15. 16,

(**) Syntagma de alimentorum facultatibus—Simeonis Sethi, 73, 10,

(3) Chapter I. verse 6.

(4) Chapter III. verse 5.

(†) I do not know the origin of the name "Fève de Pythagore" which is given by some French authors to the carob. This name is also given to an aquatic plant (*Nelumbium speciosum*) which grows in hot countries (Bulletin de la Société Nationale d'acclimatation, 1896, p. 189.)

The Carob-tree is to be met with at present, either in its wild or cultivated state, on the warmer coasts of the Mediterranean and especially in Syria, Palestine, Rhodes, Cyprus, Crete, and some islands of the Aegean and Ionian seas, in certain parts of Greece and Asia Minor, in Malta, Sicily, Sardinia, Corsica, in the South of Italy, in certain parts of France, in Spain, in Portugal and throughout the northern shore of Africa, where the climate is congenial to this tree, which A. du Breuil called "le Roi des végétaux africains."

The Carob-tree was brought by the Spaniards to Mexico and to some other parts of South America, and by the English to South Africa, Australia and Eastern India.

Description.

The Carob-tree belongs to the class of *Leguminosae* and to the family of *Caesalpineae* and is the only species of the genus *Ceratonia*.

It is an evergreen and long-lived tree, which easily renews itself from the root, growing as high as 30 to 40 and sometimes, 50 to 60 feet. The diameter of the trunk sometimes reaches 4 feet.

It thrives in any kind of soil and especially in porous, marly and volcanic soils; but not in marshy lands. It will grow and develop even in the driest and rockiest ground and resist wonderfully continued drought owing to the very long tap-root it develops; but it cannot stand without bad results a temperature of -3° C; for this reason it always thrives better near the sea.

In places where Citrus trees can grow in the open the Carob-tree is able to bear fruit; but it cannot grow further north than the zone of the Olive-tree.

It develops quickly in a fertile soil, whilst its growth is slow in rocky and dry places.

Leaves and Head.

Its leaves are equally pinnate, composed of 6 or 8 and more rarely of 4—6 or 10 (very seldom 7 to 9) leaflets which are oval, entire, leathery, dark green and smooth above, paler and dim below. As it bears a regular ramification and thick foliage, in a comparatively fertile soil it develops a regular hemispherical head.

Suitable for Avenues.

It is exactly on account of its thick and well formed head, as well as on account of its longevity and wonderful resistance against drought, that the Carob-tree is successfully used also as a tree for avenues.

However, the Carob-tree presents for this use two disadvantages: first, that the scent of its male flowers is not generally liked and, secondly, when transplanted it takes root with difficulty. But the first can be avoided by grafting a female graft on it and the second by transplanting it when young.

Flowers.

The Carob-tree bears many small flowers, of a greenish colour, attached to a cylindrical, straight axis, seldom bifurcated. The calyx, when the flower is still closed, and the axis are red.

Before the flowers open the axis, which bears them, has the shape of a piece of red string, for which reason the flower in this period is very properly called by Cypriote farmers the “σπάγος” (i.e. string).

This axis when fully developed may be as long as 10 inches, and it usually bears 30—60 flowers and often many more (I once counted 135).

The flower axes grow generally on the branches which are more than one year old and rarely on the trunk of the tree. In years promising a large crop, the Carob-tree will bear flowers even on shoots of one year.

The flowers commence to appear from the month of July, but become numerous in August and September. They usually open and fecundate in September and October, but in the hotter parts of Cyprus, and especially on the coast, they begin to open as early as the month of August.

The Carob-tree sometimes, for atmospheric reasons, besides its autumn flowering, flowers also in winter, but seldom in abundance, as, for instance, was the case here in 1898—99, when flowers appeared even in November, December and January, many of which were fecundated and the fruit they ultimately formed ripened in due season with the other fruit.

Fecundation.

Botanists say that the Carob-tree is a *polygamous triæcious* tree, because there are Carob-trees bearing only male flowers, others bearing only female and others only hermaphrodite flowers, that is, flowers having both the male and female organs.

The trees which bear only male flowers, are those which are called in Cyprus and elsewhere *male* Carob-trees; these never give fruit; whilst *female* or *fructiferous* trees are those which bear only female flowers.

Hermaphrodite Carob-trees, that is to say Carob-trees the flowers of which bear both male and female organs fully developed, are not to be met with either in the East or in Italy; such Carob-trees are to be found in Spain and may be considered as forming a special variety, which however, is not appreciated on account of the small quantity of fruit it produces.

However, on a flowering axis of a female Carob-tree 1 or 2 flowers may be met with bearing one or more stamens fully developed and resembling in all respects the stamens of the flowers of the male tree. But this is an extremely rare case, which cannot be taken into account when the question to be considered is how the flowers of the fruit-bearing or female Caroub-tree are fecundated.

The Carob-trees raised from seed are either male or female, that is, fruit-bearing or non-fruit-bearing. But the fruit of such Carob-trees is, as a rule, small and thin, for which reason, these trees, whether male or female, are called *wild*, and they are reclaimed by grafting them with scions taken from fruit-bearing trees, known to be healthy and prolific.

The custom which prevails in making fruitful all the *wild* Carob-trees within a certain area by grafting, is rightly condemned by some people, but in my opinion not for the reason given by them. They maintain that, besides the hermaphrodite variety to be met with in Spain, the

flowers of which bear male and female organs, all the other fruit-bearing Carob-trees are destitute of male organs, and that therefore, the presence of a proportionate number of male Carob-trees in a Carob grove becomes indispensable in order that the fecundation of the flowers of the female trees, and consequently the increase of their fructification, may be secured.

This observation would be absolutely true if all the flowers of the fruit-bearing Carob-tree were entirely destitute of male organs and consequently of pollen, the fecundating power, which is indispensable in the formation and ripening of the fruit.

That this is an indispensable necessity is known to the farmers of the East in connexion with the cultivation of other diœcious trees, as for instance, the date Palm and the Pistacio-tree, which do not bear fruit unless they are adjacent to other male trees of the same species or unless they are fecundated artificially, as is done in Cyprus by the so called *taïma* of the date Palm-tree.

However, in Cyprus as well as in the other parts of the East, where the Carob-tree is cultivated on a large scale, it has not been observed that the presence of a male tree, even in these very extensive Carob-groves, which are exclusively formed of fructiferous trees, is absolutely necessary.

It is not possible to suppose that the flowers of these trees are fecundated by the help of the wind in conveying the pollen from distances where male Carob-trees may be growing, because if this were the case the fact would have been observed by the farmers who are observant in such matters: *e.g.*, they would notice if their trees bore sometimes more fruit on the one side only: that is to say if it was the side on which a male tree was standing and if during flowering the wind blew from that side.

Besides, during the period the Carob-tree is in full bloom (in September or October) winds are not frequent in Cyprus. Moreover, inasmuch as the flowers grow in the interior of the head of the tree, and consequently are covered with thick foliage, it would hardly be possible for it to be fecundated by the help of the wind only.

This latter fact having been admitted by those also who believe the flowers of the fruitful Carob-tree to be female, say that this tree is not an *anemophilous* tree but an *entomophilous*, that is to say, that the flowers of the fruitful Carob-tree are fecundated not by the help of the wind but by the help of insects.

It has long been known that insects greatly contribute to the fecundation of all plants and that consequently, in this respect, many insects, and especially meliferous insects, are very beneficial to agriculture.

Any person during the time of blooming going through a large Carob-grove in which no male trees at all or very few only are to be found, will certainly find it difficult to believe that it is possible for insects, no matter how large their number may be supposed to be within that space, to visit even a small portion of the multitude of flowers on the thousands of Carob-trees which bear fruit every year.

It should also be remembered that during the flowering of the Carob-tree (in autumn) very few insects comparatively are alive; and as this tree, as a rule, is to be met with in comparatively the driest areas of the Island, bees will assist very little in the fecundation of its flowers, because landowners rarely keep hives within these areas.

Bearing all this in mind and with the knowledge that in such places, at least, complaints have never been heard of an irregular fructification taking place with regard to any specified Carob-trees, which could be attributed to the want of wind or to the distance of the trees from places where hives were kept, I have come to the conclusion that the fruit bearing Carob-tree, which is supposed to be female, must be partly, at least, fecundated by itself, that is to say that it must have many flowers bearing male organs also.

Thus could the fact be explained that the only Carob-tree at Parramatta, in New South Wales (Australia), a tree 30 years old, bears abundant fruit regularly ⁽¹⁾, and the same reason can be given in explanation of the regular fructification of the sole Carob-tree which grows at Funchal in Madeira ⁽²⁾.

The correctness of my conclusion is supported by detailed observations on many flowers which I carried out in the autumn of 1899.

A person examining attentively, by the help of a lens, a flower of the fruit-bearing Carob-tree as it opens, will see that near the edges of the disk and underneath the tip of every sepal of the calyx (which tip bends inwards towards the disk) there is a small red stamen, or rather its sessile anther. These atrophic anthers dry up 3 or 4 days after the opening of the flower and when dry resemble small black spots.

So then, of these male organs the comparatively better developed must be those which contribute to the fecundation of many flowers of the fruitful Carob-tree, whenever no male subjects grow near it.

But exactly because these male organs, which are always to be found in the flower of the fruit-bearing Carob-tree, are not fully developed, the presence of male trees, that is to say of perfect male flowers, is necessary for the increase of fructification.

This increase in the fructification should be achieved by planting or by allowing male trees also to grow at distances in the Carob-grove and not (as some advise) by allowing or helping (by grafting) the development on a fruit Carob-tree of a wild branch bearing male flowers, because such a branch would always predominate on a fruit-bearing tree to the detriment of its general development.

The keeping of bees in a Carob-grove or near it is also very effective in increasing fructification.

Fruit.

The fruit, which is formed and remains after the fecundation of the flower, grows very slowly until the month of March, at which time the bean is, as a rule, about an inch long. From this month, however, it

(1) *The Agricultural Gazette of New South Wales*, 1897, page 493.

(2) *Kew Bulletin of Miscellaneous Informations*, 1898, page 184.

commences to grow fast and its growth and ripening is completed about the beginning or the middle of the month of August. So that at this period there may be found on the Carob-tree flowers together with fruit already formed but yet very small, as well as fruit quite ripe and ready to be gathered.

However, sometimes, on account of exceptionally favourable atmospheric circumstances during the autumn, young fruit develops much quicker and consequently in December and January carobs of various sizes are to be seen on the trees, and amongst them some, which although full grown, are still green. These get ripe only a few weeks earlier than the others.

The fruit of the Carob-tree is a flat bean and more or less twisted (like the horn of a goat) and it is on account of this shape that it was called by ancient Greeks *κεράτιον* and the tree *Κερατέα* or *Κερωνία*.

The fruit of the wild Carob-tree when ripe is chestnut-coloured, short, narrow and thin. I have met with wild Carob-trees the ripe beans of which were about 3 inches long, about half an inch wide and $\frac{1}{8}$ of an inch thick.

When the fruit of the grafted tree has reached its full growth and is ripe it is 6 to 10 inches long, more than 1 inch wide and about $\frac{1}{2}$ inch thick. It is covered by a rather leathery dark chestnut-coloured coat and its flesh is very sweet and often honeyed, enveloping 12-18 seeds of a deep red colour, of a lenticular shape, lying lengthwise in the fruit, each in a separate cell.

Use of the Fruit as Food for Man and Cattle.

This fruit has long been in use all over the East chiefly as a food for cattle and in a lesser degree as food for the poor classes.

Carobs have also long been used as food for cattle and especially for pigs, mules and horses in Spain, Portugal, and Italy, where they sometimes also serve as food for man.

The average annual production in Italy is about 90,000 tons and nearly all this quantity is consumed locally.

In Naples the horses of public vehicles as well as cart horses are given for their daily food 6 kilogr. of broken carobs, 6 kilogr. of bran and 10 kilogr. of hay.

It is due to this diet that the horses of Naples are renowned all over Italy for their endurance, their ability to stand hard work and for their good appearance. *

Carobs have also for some years past been largely used in France and especially in England for feeding horses and milch cows and for fattening oxen.

A large proportion of the carobs produced in Portugal, Spain, Crete and Cyprus are sent to England, where they are ground and mixed with beans and other substances and used in preparing the *Patent Cattle Food* †,

* Bollettino di Notizie Agrarie, 1897, page 36.

† Carobs ground with their seeds constitute the main ingredient of the *Patent Cattle Food*. The seeds, according to the assurances of the French Chemist Jean Effron, contain, besides the other ingredients, 19% of nitrogenous substances and a hydrocarbon hitherto unknown, which has been called by this Chemist *Caroubine* (Comptes Rendus, 1897, No. 125).

common use of which is made for feeding horses, oxen, milch cows and mules. This food is especially suitable for sickly cattle requiring strengthening food.

Composition of the Carob.

The daily extending use of carobs as food for cattle, (especially in countries which do not produce carobs and where they are consequently burdened with additional expenses, such as commission and transport) is due to their nourishing power, which is chiefly attributed to the great quantity of sugar they contain, as well as to the great quantity of nitrogenous and other, for the most part digestible, substances. ‡

From many analyses made it appears that carobs contain as much as $8\frac{1}{2}\%$ of nitrogenous substances * and 50% sugar (†).

In the table below, drawn up by L. Grandean (†), carobs are compared with other products as to their nourishing power.

Products.	Nutricious unity in 100 kilogrammes.	Kilos. of other pro- ducts corresponding to 100 kilogs. of wheat.
Wheat	137.4	100.0
Maize	126.4	108.0
Rye	125.7	109.7
Bran of Wheat	121.8	112.8
Bran of Rye	121.8	112.8
Barley	106.4	129.1
Oats	103.2	133.2
Buck-wheat	99.5	138.0
Carobs	93.1	147.5
Acorns (half-dried)	68.9	199.0
Beans	185.4	74.1
Peas	177.0	77.4

A certain quantity of carobs is used for human food in the countries where they are grown as well as in Russia, where the most selected carobs of Crete are sent, and in Egypt, where the choicest Cyprus carobs (those of Pyrgos) are consumed.

‡ MacDonald estimates the digestible parts of carobs to 82% (Cattle, Sheep and Deer: Appendix, page LIV).

* Analysis of carobs of various origins (from the Bollettino di Notizie Agrarie, January, 1897, page 30-31).

Constituents.	E. Wolff.	J. Kühn.	Muntz.	Göhren and Settegast.	Simonetti	Iosa.
Water... ..	13.0	15.0	16.0	13.5	19.0	15.6
Ashes	1.8	2.5	2.2	2.3	2.4	2.6
Proteine (nitr. subst.)	4.0	5.9	5.3	6.8	5.8	8.5
Fatty matters	2.8	1.3	0.5	1.0	0.9	0.8
Extract not nitrogenous	73.8	68.9	76.3	70.9	65.4	63.3
Fibrine	5.9	6.4	—	5.5	6.5	9.2

† Analysis of carobs of Provence (Revue des Sciences Naturelles Appliquées:

Other uses.

The Turks, Arabs and Fellahs prepare from carobs and liquorice refreshing beverages, their favourite *Sherbets*. The Fellahs prepare also cheap sweets from carob flour (used instead of sugar) and the fruits of *Tamarindus indica*, *Prunus myrobalana* and others fruits. The inhabitants of the Levant as well as those of Africa in times of famine also make use of caroubs in preparing a kind of bread ⁽¹⁾.

Fried carobs are often used in Spain for the adulteration of coffee and chocolate ⁽²⁾.

Honey and Sugar Candy.

A kind of molasses and candy sugar, which is called *pasteli*, is obtained from carobs in Cyprus. From 15 okes of carobs about 8 okes of molasses, or about 6 okes of *pasteli*, are obtained.

To make the molasses, carobs are ground, by hand mill, and the flour thus obtained is placed in a basket which is put above a cauldron. The flour is then washed off by pouring over it at intervals cold water until all the sugar is dissolved and washed away. The water thus passed through the flour and collected in the cauldron under the basket is evaporated on a fire until it has acquired the consistency of honey, when it becomes of a deep chestnut colour.

If the evaporation is prolonged and the syrup is well and continually stirred with a long wooden spatula the so-called *pasteli* is obtained.

Spirit.

Carobs are also used in distilling, when they yield 18-25% spirit of good quality.

For this purpose finely ground carobs are soaked in treble the quantity of hot water so that all the sugar contained therein may be dissolved. When the sugary liquid thus obtained has somewhat cooled the proper quantity of beer yeast and a little sulphuric acid (2 per 1000) is added; after fermentation it is distilled. The residue is used as food for cattle; especially for pigs.

A great quantity of carobs was formerly used in France and Austria in distilling. However, it appears that distilling is not profitable when the price of carobs is higher than 10 fcs. per 100 kilogr.

1894, page 238).

Grape sugar	...	...	17.165
Fruit sugar...	...	...	32.201
Stable salts of ashes	...	...	2.437
Wax, tannin and colouring matter..	...	...	4.501
Albuminoid, pectine, gum	...	...	7.750
Cellulose	...	...	34.946
Loss	...	...	1.000

† "Semaine Agricole," 1899, page 420.

(1) Revue des Sciences Naturelles Appliquées, 1894, page 237.

(2) L'Eco dei Campi e dei Boschi, 1896, page 528.

Pharmaceutic use.

Galenus considers carobs as being woody and indigestible and their juice as unhealthy ⁽¹⁾, whilst Dioscorides says that they are diuretic and more stomachic when dry ⁽²⁾. This fruit has long been used by druggists in preparing various potions against acute catarrh of the bronchi ⁽³⁾.

Wood.

The sapwood of the Carob-tree is whitish, whilst the heartwood is of a fine red colour with veins; hard and heavy and making very good fuel. Charcoal can be made from it when it is not rotten or very young.

The heartwood, of sound trunks, without knots, can be used for making carts and for cabinet work, because it is easily worked and polishes very well. Although its density is 0.827—0.908 it does not withstand much moisture.

Tannin.

The leaves and bark of the Carob-tree contain a certain quantity of tannin, and for this reason they were formerly used in tanning.

The fruit also contains a quantity of tannin and some colouring substance when still green, and it is therefore sometimes used in dyeing.

Gum.

The trunk of the Carob-tree sometimes yields gum, similar to that of the Almond tree, which can be used for industrial purposes.

Dyeing substance.

It is said that the seeds of the Carob-tree contain a vivid yellow colouring substance and that it was formerly used in dyeing (*).

Seed used as a weight unit.

It has also been said that the seeds of the carob were originally used in fixing the carat, and that for this reason this unit was called *κεράριον* in Greek; but this does not seem to be the case, because the seed of a climbing asiatic plant *Abrus pectoratus* ** was from all appearances used for this purpose.

Varieties.

If in order to determine the varieties of the cultivated Carob-tree the fruit is taken as a basis, it would then be impossible to distinguish any other varieties but those determined by Risso, that is to say, the

(1) "Simeonis Sethi." "De alimentorum facultatibus." 73, 15.

(2) Dioscorides, A., 158.

(3) Revue des Sciences Naturelles Appliquées, 1894, page 238.

* Notice sur les forêts de l'Algérie, page 31.

** Dictionary of the economic products of India "*Ceratonia Siliqua*."

common Carob-tree (*Ceratonia Siliqua Vulgaris*) and the broad-fruited (*Ceratonia Siliqua Latissima*) †.

The former bears fruit which although marketable is more or less straight and short, and this is the variety known in Cyprus by the name *Kountoura* or *Apostoliké*. Trees of this variety can also grow from seeds which sometimes happen to germinate in cultivated lands, for which reason this variety is called in some places *Apostoliké* as though sent by chance or by Providence.

The latter variety of the Carob-tree, which is especially cultivated and reproduced only by grafting, is that which bears fruit larger in length, broader and more sugary: this is the kind the most appreciated by the trade.

This undoubtedly is the variety known by the name *Rocha* in Spain (Valencia) and *Feminello* or *Zuccherino* in Italy and thrives especially in fertile and deep lands.

But as we have said above, the hermaphrodite Carob-tree of Spain, called there *Matalafan*, and the fruit of which appears to resemble that of the common Carob-tree, can be considered as a variety in itself.

Besides the above mentioned three varieties, almost in every locality where the Carob-tree is cultivated some sub-varieties or kinds of quite a local character may be distinguished, inasmuch as on being removed from one place to another they may produce fruit, the distinctive characteristics of which may more or less change.

Thus, in Kyrenia the kinds known as *Templiotike* and *Kyrniotike* are distinguished. In Leonariso there exists a kind known by the name *Sarakine* (Query: introduced by the Saracens?) In other parts of the Island the growers distinguish a kind called *Vaklitike* and another called *Kombote* which is so called because the fruit is knotty. On the other hand again, distinction is made in other parts of the Island between the *Apostolike* and the *Koundoure* Carob-tree.

The trade makes a distinction in qualities of carobs, which usually take the name of their origin. The carobs of Pyrgos in Tiliria are considered to be and are of superior quality. They are large and thick, the inside is sugary and of a whitish colour; they are rarely attacked by insects, and for this reason keep in good condition for a long time. These carobs are usually valued at 2-3 shillings per cantar (180 okes) more than the others. Nearly the whole crop of the Tiliria is consumed in Egypt where the Fellahs eat them or prepare refreshing beverages from them.

On the other hand, the carobs of the Karpas are of inferior quality. The inside is of a dark colour and is, as a rule, worm-eaten; for this reason they do not keep long.

† The wild Carob-tree is the type of the species *Ceratonia Siliqua*, and its chestnut coloured, thin, short and rather woody fruit, as we have said above, is not marketable. However, it is sometimes collected by the villagers from the forests to feed pigs. And as in the cultivated so in the wild Carob-tree one can clearly distinguish two varieties. I happened to collect beans of wild Carob-trees, differing from each other so much that, if one were to compare them without having regard to the trees, he would come to the conclusion that they came from trees of two distinct species.

The existence of so great a difference in the qualities of carobs is, certainly, due chiefly to climatic influences and the soil, but in a great measure also to the time of their collection. In order that carobs should keep long, they must be collected when quite ripe, that is to say, when they commence to fall from the tree by themselves. Then, the end of the fruit near the pedicel is no longer greenish, but of a deep chestnut-colour, and the pedicel itself blackish and dry.

Climate and Soil.

The Carob-tree thrives and yields a paying crop in every country where the winter is not severe, where water rarely freezes, where the centigrade thermometer never goes lower than—3°.

It grows and gives fruit in countries where the winter is colder, as for instance, in Attica; but in such countries its cultivation as a productive tree is not a paying one, because a temperature lower than 3 degrees below zero may destroy even the trunk of this tree. In such a case however the root which remains intact, gives out shoots again, as was observed in Attica (in 1850).

The requirements of the Carob-tree as regards soil are very limited. Except marshy or very damp soils, all others, and even very rocky soils are suitable to its development. A crack in a rock is sufficient for a carob seed, dropped in at the proper time, to germinate and produce a flourishing tree.

Nevertheless, the Carob-tree seems to succeed better in marly lands and to yield choicer fruit in volcanic and porous soils when they are fertile.

Propagation.

The reason why the Carob-tree can grow even on rocky soils and is able to withstand the most continuous drought should be attributed to the long tap root it develops whereby it draws up from the lowest strata the moisture required for its existence.

But it is exactly on account of this nature of its root that this tree, when transplanted in an advanced age, or even when taken from a seedling bed when comparatively young, very rarely takes root, unless such care were to be taken as from a practical point of view would not pay.

But even if the transplanted carob-tree takes root, it will constantly require special care, as it will no longer form a tap root to enable it to resist the continual drought of the countries where this tree is usually cultivated. This having been taught to the land-owners of Cyprus and other countries by experience, they never form Carob-groves or fill up the bare spaces therein by transplanting large trees or even young trees taken from seed-beds, nor do they ever propagate this tree by cuttings, as some have suggested.

To obtain robust trees capable of resisting continual droughts they should be grown from seed, sown either on the spot or in receptacles.

The plants grown in receptacles are planted at the place required within the first year of their growth, when their tap root is still tender and can easily take its natural direction downwards.

The seed obtained from the residue of carob molasses, which is made in many parts of the Island, is usually used for sowing. It is sown in the months of February and March in preference and as the seed is very hard, it is, before sowing, either soaked in water or stratified in a box with fresh and damp manure.

The seed remains soaked or stratified until its perisperm bursts and the germ begins to show itself. Until then the water in which the seed is soaked should be changed every day so as to prevent fermentation which destroys the germinating power of the seed.

When sowing the seeds in the places desired they should be either sown sparsely in the field, which should be subsequently turned up with the plough, or thinly thrown in furrows (about 35 feet apart from each other) opened and subsequently covered by the plough, or they should be buried in small pits dug for the purpose at distances of about 20 feet. In each pit 4 to 5 seeds are placed and covered with a layer of mould or rich soil about 3 inches thick.

When sowing in receptacles, use is made either of pots, as is the case in Cyprus (and this mode is preferable), or in wooden boxes or in baskets, as is the practice in certain parts of Italy.

The receptacles are filled with mould mixed with river sand. Two or three seeds are placed in each receptacle.

It is not indispensable that seeds sown in the ground should be watered, but seeds sown in receptacles should be watered both before and after their germination whenever the necessity is observed.

Seeds sufficiently soaked or well stratified when sown in receptacles germinate within 7—10 days, whereas when sown in the ground they germinate within the same time if the weather be favourable; but if the weather is dry the seed may remain in the soil without germinating for many days or, if its perisperm has not burst, a whole year may elapse before it germinates unless it is watered. But if it is watered it germinates in due time.

The Carob-trees grown in receptacles may be transplanted to the spot where it is desired to plant it at any time between the autumn immediately following the sowing and the following spring. However, it is preferable to transplant them in autumn.

And if the plants are in pots they should be taken out with the lump of earth round their roots and planted with care in the places desired. But if they are in baskets or boxes they should be planted together with them after carefully removing the bottoms of the boxes only; the baskets should be left whole.

Soon after transplanting—as well as during the whole of the following year and during the dry season especially—the young plants should be watered at least every fortnight. It is preferable that they should be watered in summer in the evening or at night. After each watering, the ground round the plants should be hoed or, better still, covered with brushwood.

Distance.

The distance one tree should be planted from the other is hardly ever taken into account in Cyprus, because the Carob-groves in the Island are formed mostly from spontaneously-grown wild Carob-trees which had either been grafted long before or were about to be grafted. They are allowed to grow as they are in the field, that is to say, either too closely together or too far apart.

But even in places where the tree is propagated from seed no attention is paid to distance. In such places the carob-seed is sown when the field is about to be ploughed early in the spring so that it might be sown with wheat or barley the following autumn. Thus, from the plants which may grow in this field those remain and develop which happen not to be uprooted by the native plough during the autumn sowing.

Only a few proprietors fill up the bare spaces with a new sowing of seeds or by transplanting, and I have not known anybody to make up his mind to thin Carob-trees in a densely planted grove.

However, the distance at which Carob-trees should be planted should necessarily vary according to the fertility of the soil. In very rocky and sterile land where Carob-trees develop slowly and rarely grow very large, no harm is done if they are planted very near to each other. But in fertile land where this tree can, within 30 years at most, cover with its branches over 1,000 square feet, one tree should be at least 35 feet distant from the other, especially since the land can, with advantage to the trees, be sown with cereals.

A year after transplanting or sowing the young plants should be thinned by leaving in each spot only the most robust which should then, and in every subsequent winter until it is grafted, be pruned, by cutting off all the sprouts from the main stem.

Grafting.

When the young tree has become about 7 feet high and has a diameter of one inch at a height of 3 feet from the ground it is grafted by budding. The budding should be made during the month of May when the bark separates easily from the wood.

More buddings than one can be made on the older trees, and they should be made not on the trunk but on the branches, which should be cut down to a height of 6—9 inches above the buddings, some twigs being left on the tree and over the buds in order to prevent them from being choked by the ascending sap, which is abundant during that time.

Manuring.

With regard to manuring, the Carob-tree is not exacting. In fertile soil organic manures which are the only manures known in Cyprus are not only unnecessary for a full grown and already fruit-bearing tree, but may also become injurious, because they may induce the tree to produce wood and leaves to the detriment of the fruit, and also superficial roots which, when the summer heat and protracted drought set in either cease to act or die.

Moreover, in Cyprus the wants of this tree as well as of the cereals which are usually sown under it are partly met by the manure left by the flocks which graze in the Carob-groves during a great part of the year. Further, the fields are fertilized by the rain waters which during the autumn come down from the hills saturated with organic matters and which are carefully caught up by the farmers and let into their fields.

Cultivation.

What is really very beneficial to the Carob-tree and which is admitted as being so by all and is applied more or less perfectly by the farmers of Cyprus also, is the ploughing at least of the area shaded by the tree.

When the nature of the soil allows its being cultivated, that is, when it is not quite rocky, it is ploughed by the native plough several times a year if the land occupied by the carob-trees is to be sown, and once or twice—in autumn or spring—if it is to remain fallow.

I consider it very beneficial that the land under Carob-trees should be as perfectly ploughed as possible during autumn and spring, because when the ground under trees, is loose, the storing of a greater quantity of rain water near their roots is facilitated in autumn and its quick evaporation is prevented in spring. For these reasons the deeper these two ploughings are, the more effective they will prove.

Moreover, deep ploughings round the tree have, in addition to this beneficial effect and that derived from the aeration of the earth (and the good results of aeration we know), the great advantage that they destroy the superficial roots of the tree. Thus the tree is forced to develop and strengthen its deeper roots which function perfectly even during protracted droughts.

Mixed Cultivation.

In Cyprus as well as in other parts of the East, where the Carob-tree is cultivated, this tree is very commonly found growing with the Olive-tree, and the land under the tree when arable is sown with cereals especially. This sowing is not only harmless to these trees but is indeed beneficial for the reasons mentioned above.

Pruning.

In September or October, when the grafts have already sufficiently developed, all the wild branches left during the grafting, those which have developed after that, as well as the sprouts growing from the graft and lying close to each other or growing across each other, are removed in order that the interior part of the head of the tree should remain more or less free.

With the exception of the above no other living part of the head of the Carob-tree ought to be removed during the whole of its life because all these parts either bear or will bear fruit. And it is exactly on account of this reason that pruning properly so called is nowhere applied to this tree.

It is of course, unnecessary to add that dead branches or wild sprouts, whenever they appear, should be removed. The real purpose of

the removal of the former is to obtain fuel and give a better appearance to the tree. As far as appearance is concerned, however, most owners do not take very much interest; especially as the Carob-tree has been endowed by nature with a very regular head.

So far as pruning is concerned the only advice which one can give to Cyprus cultivators is that they should clean more regularly and more carefully the wild Carob-trees which are to be grafted and many of which are still to be found growing spontaneously in the Island.

When the branches are to be removed from the trunk of such a tree they should be cut off with a saw, the unnecessary branches being cut off to the base and those which are to be grafted obliquely and at the proper height from the base. The wounds so caused on the trees with the saw should be subsequently smoothed with an adze or sharp knife, that is, the edges should be cut smooth and afterward smeared with a mixture of clay and ox-dung.

The wounds will in this way heal up quickly by being covered with new bark, and the commencement of decay of the wood will thus be prevented. Decay, when developed in wounds not healed up, gradually extends downwards and at last makes the trunk hollow.

It is exactly on account of the carelessness with which the wild Carob-trees in Cyprus are pruned, when being prepared for grafting, that one rarely meets with a tree with a sound trunk. And besides the fact that they do not last long, trees with hollow trunks have also the disadvantage of giving shelter to rats, which are so prejudicial to the Carob-tree as we shall see further on.

Regeneration.

The Carob-tree may in comparatively fertile soil live for more than a century, and bear fruit regularly. But, as is the case with other trees, it also at last attains the age of decrepitude, although its root may live longer and produce new shoots.

An old Carob-tree which falls to the ground on account of old age or is broken by a violent wind is regenerated in Cyprus in the following way: during the winter the main part of the tree having been removed, a quantity of branches and brushwood are piled up round the base of the trunk and set fire to.

In this way the part of the tree left above the surface of the ground is burnt while its root continues to live, so that in the following spring many sprouts shoot up from the root which within two or three years are ready to be grafted.

It is said here by farmers that the reason for burning the trunk of an old Carob-tree is that the vermin living therein are destroyed. I think, however, that the principal object of burning is to supply to the root potash, the utility of which to fruit trees, in general, we all know.

A similar manuring with potash is unconsciously afforded by the Cypriot farmers to old Olive-trees when they are sometimes regenerated in the same way.

Fructification.

Ottavi ⁽¹⁾ and Pasquale ⁽²⁾ make mention of the Carob-tree as a tree of absolutely *intermittent* fructification, meaning that as is the case with the Olive-tree so also the Carob-tree, when the crop in one year is large in the following year the crop will be very small or insignificant. This I have not observed either in Cyprus or in other places of the East.

A decrease is actually noticed in the fructification of the Carob-tree which has borne abundant fruit in preceding years, but this diminution is not so conspicuous as in the case of the Olive-tree.

An intermittent decrease of the crop of the Carob-tree is conspicuous only in isolated trees and not in the crop of a whole area as happens with the Olive tree.

The accuracy of this statement is further shown in the table given below of the carobs produced in Cyprus during the last 20 years.

The Carob-tree gives abundant fruit in Cyprus when there is much rain in winter. Really bad crops are quite exceptional, and moderate crops come twice as often as abundant ones—this is a fact which has long since been ascertained ⁽³⁾.

Whether young or old, it commences to bear fruit usually in the third year from the time of its grafting—in the fourth year after grafting it rarely bears more than 10 to 15 okes of fruit. But from the fifth year it commences to yield a satisfactory crop which every year increases for many years if the tree grows and develops under favourable conditions.

The Carob-tree in Cyprus, when full grown, bears on an average about 50 okes of carobs annually. However, many trees are to be found which, when growing under more favourable circumstances, yield 400—500 okes of carobs.

At Pyrgo in the Tilia mention was made to me of a Carob-tree which produces about 1,000 okes of fruit of the best quality, and I should have doubted the accuracy of this information, had not similar prolificness been observed elsewhere.

Thus, Comte de Gasparin states that in Valentia Carob-trees were observed bearing as much as 1,380 kilogrammes (1077 okes) of fruit (*) and Pasquale, in dealing with the cultivation of the Carob-tree in Italy, says that large trees occupying a surface of over 100 square metres can produce as much as 1,000 kilogrammes (780 okes) of fruit (†).

(1) L'Agricoltura meridionale, page 305.

(2) Manuale di Arboricoltura, page 386.

(3) Gaudry. Recherches Scientifiques en Orient-Partie agricole, page 90.

(*) Cours d'agriculture, Tom. IV., page 530.

(†) Manuale di Arboricoltura, page 386.

Yield per donum.

It is difficult to estimate the yield of this tree per donum because, as we have seen, Carob-groves in Cyprus, as well as in other parts of the East, are not systematically planted.

Amongst Carob-trees there are usually to be found other trees also, and especially the Olive-tree, or there may be more or less large bare spaces. Moreover, in one and the same Carob-grove some trees often grow very big whilst the growth of others is very slow; this is the case also in other countries bordering on the Mediterranean, in which the Carob-tree is cultivated—for this reason the yield per extent of land is nowhere mentioned with accuracy.

However, taking as a basis that the average of the yield of every tree is 50 okes of carobs and that for each of these trees an area of 800 square feet, at least, is needed, we should calculate 18 trees per donum ⁽¹⁾ yielding in all about 900 okes of fruit a year.

This calculation is almost 30% lower than that made, also on suppositions, by Ottavi, who states the yield of the Carob-tree per hectare in Sicily to be about 10,000 kilograms and he hence concludes that a hectare of Carob-grove yields a much greater and surer income than the best grass-pasture in the world of an equal extent of land ⁽²⁾.

Considering the price of carobs, our calculation is by far much lower than that made by Pasquale also on conjectures: He states that since a large well cultivated Carob-tree can produce fruit valued at 150 francs the average annual income of one hectare of a Carob-grove may exceed 2,500 francs ⁽³⁾.

Collection.

When the carobs are quite ripe, that is in August, they can be easily removed from the tree, by knocking them down with canes or long thin sticks. They are then picked up from the ground, put in sacks and brought directly to the store or heaped up on a high place in the open air, where they can remain for a long time without any risk of being damaged, because it very rarely rains in Cyprus during that time of the year.

But in case of rain the damage is not irreparable, as the surface of the bean being leatherlike and smooth, the carob does not retain the water and become damp. The water runs off the surface without soaking through the heap and two or three day's sunning in August would suffice in Cyprus to evaporate all the moisture which the surface of the heap may have retained after rain.

⁽¹⁾ Three Government donums are equal to an acre, that is, each donum contains 14520 sq. feet.

⁽²⁾ *L'agricoltura meridionale*, page 305.

⁽³⁾ *Manuale di arboricoltura*, page 387.

For this reason all the crop at Pyrgos and the surrounding villages which amounts to 3-4,000 tons, and which is considered of the best quality, and also the crop of other villages of the Island, is collected together every year by the merchants who purchase it, and heaped up along the shore; it is left to remain in the open air for 3 or 4 weeks until it is shipped.

In the Carpass, on account of purely local reasons, carobs are usually collected before they are quite ripe, and in this state, if stored at once, they rot; many people for this reason before storing usually spread them for some days on the terraces of their houses to dry. This course is, of course, good, but it would be preferable to collect the fruit when it is quite ripe.

Consumption.

The consumption of carobs in the Island is insignificant. The Carob-growers transport all their crop—with the exception of small quantities which are eaten or used in making carob molasses and *pasteli*—within the first 2 or 3 months after they are gathered, to the towns and ports of the Island and sell it to the merchants there.

The carobs are transported from one place to the other on donkeys, mules and camels and sometimes by carts in sacks containing from 60 to 100 okes.

The main portion of the carob crop is exported to England, France and Egypt. During the period of five years from 1894-1898 the 7/16 of the Cyprus crop was exported to England the 5/16 to France and the 1/16 to Egypt. The remaining 3/16 were divided amongst Italy, Spain and some other countries. The first merchant who commenced the exportation of Cyprus carobs to England was the late Mr. D. Pierides.

Gaudry mentions (*) that on his visit to Cyprus in 1853 carobs were exported to Russia, Egypt, Sardinia and Austria. He adds that the Cypriots used at that time to fatten mules and other cattle with this bean. Certainly, since that time, the constitution of Cyprus animals has not changed and they consequently would be benefited if even now they were fed on carobs in spite of the assurances to the contrary of the Cypriots of the present day.

The following table shows the total annual exportation in Aleppo Cantars of carobs from Cyprus between the years 1879—1898.

Years	Aleppo Cantars (†)	Years	Aleppo Cantars (†)
1879	114·454	1889	103·123
1880	67·096	1890	120·786
1881	47·037	1891	163·879
1882	87·980	1892	131·612
1883	117·799	1893	105·231
1884	128·368	1894	121·073
1885	122·379	1895	155·199
1886	110·727	1896	176·584
1887	88·899	1897	137·994
1888	56·501	1898	107·993
Average	94·124		132·347

(*) Recherches Scientifique en Orient—Partie agricole, page 172.

(†) Aleppo Cantar corresponds with 180 Cyprus okes or with $4\frac{1}{2}$ English cwts, or with $228\frac{1}{2}$ kilogrammes,

Remarks on the foregoing table.

Since, as we have already said, the local consumption is practically insignificant, the above figures may be taken as representing the whole production of this crop, which is one of the most important agricultural products of Cyprus.

In 1854 the production of carobs in the Island was recorded as amounting to about 20,000 Aleppo cantars (4,500,000 kilos), but Gaudry is of opinion that it must have been higher, and the fact that ten years before (in 1844) the production of carobs was noted as fluctuating between 20 and 24,000 Aleppo cantars, strengthens this opinion (†).

At all events, from the comparison of the averages of the production of the last two decades we see that the production has increased by 40% during the last ten years. And as the grafting of the wild Carob-tree and its propagation by sowing constantly continue, it cannot but be that the production of this crop will continue to increase.

The great decrease in the production which appears in the above table during the years 1880, 1881 and 1888 is due to the atmospherical reasons mentioned further on.

Production in other countries.

Owing to the small extent of land which the cultivation of the Carob tree occupies in other countries bordering on the Mediterranean in comparison to their other crops, and on account of the fact that the whole or greater part of the carobs produced by these countries is consumed locally, there is very little statistical information on the subject, and that which I have been able to collect is not very recent.

Spain produces every year large quantities of carobs. The greatest part of its production is consumed locally and the remainder is exported to England and France.

The production in Italy is also large. According to official information (*) the average annual production of the Italian districts in which the Carob-tree is cultivated for purposes of trade, amounted during the five years between 1890-1894, to 870,000 quintals (of 100 kilogrammes), that is, 377,000 Aleppo cantars, so that it was about three times as large as the average annual production in Cyprus during the last ten years.

The province of Syracuse (in Sicily) produces the 4/5 of the Italian carob crop, nearly the whole of which is consumed in Italy; sometimes when the local production does not suffice, Italy obtains the quantity still required from Cyprus or other places in the East.

The south of France produces only a small quantity of carobs, which is consumed locally. The production in Malta is larger but the whole of it is nearly consumed locally.

(†) *Recherches Scientifique en Orient-Partie agricole*, page 88—90,

(*) *Statistica Agraria*. Ministero di Agricoltura etc. 1896 p. 61.

In 1887 Algeria was said ⁽¹⁾ to produce annually 35,925 hectolitres (†) of carobs which were consumed locally or exported to France. The Carob-groves in that country have since then been extended considerably by the grafting of many wild Carob-trees which are to be found there.

For spreading the cultivation of the Carob-tree both in Algeria and Tunis special companies were established in recent years and their publications appear to promise success to the enterprise (‡).

A small quantity of carobs is also produced in the Canary Islands.

We know nothing positive about the extension of the cultivation of the Carob-tree and the quantity of carobs produced in the East. It is, however, certain that the Carob-tree is to be found cultivated more or less extensively in many islands and on many shores of the East, and the crop produced is for the most part consumed locally.

However, Crete, whose annual production amounts approximately to 60,000 Aleppo Cantars (*), exports most of its crop to Russia and part of it to England and France. The local consumption in that island also is small.

Carobs are also exported, but in small quantities, from Samos (534,000 okes in 1893 (**)) Rhodes, Mersina and Alexandretta.

Beyond the Mediterranean the only country, as far as I am aware, which produces and exports carobs for the most part to England in any appreciable quantity is Portugal.

The Carob-tree was, as we have seen above, introduced into South America by the Spaniards, but its cultivation there is still inconsiderable.

This tree is to be met with in some places of North America; many hundreds of seedlings were distributed in Texas and in some of the Southern States by the U. S. Department of Agriculture some years ago ⁽¹⁾.

It was first introduced into Eastern India by Dr. Royle in 1840, and cultivated in the North-west Districts of that country. However, its cultivation was spread by the efforts of Dr. Jameson since the year 1861 ⁽²⁾.

The first seeds of the Carob-tree were introduced into the Cape of Good Hope through England and sown there in 1872. From this first trial some trees are now growing there successfully and bear fruit;

(1) Statistique agricole de la France, 1887, page 208.

(†) The hectolitre of carobs is equal to about 50 okes.

(‡) La "Caroube," Société Franco—Algérienne d'épargne Agricole.—Notice sur la culture du Caroubier en Tunisie. Par M. S. Paulard.

(*) Out of this quantity the 9/10 are produced in the districts of Heraklion Lassithion and Rethimnos and only the 1/10 in the Districts of Cydonia and Apocrona.

(**) Year-book of the principality of Samos 1894, pag. 98.

(1) Report of the Secretary of Agriculture. Washington, 1893, page 374.

(2) Dictionary of the Economic products of India. "Ceratonia Siliqua."

this has induced the colonists recently to introduce young grafted trees from Naples in order that a cultivated fruit-bearing variety should be propagated ⁽¹⁾.

The Carob-tree is at present to be met with in Australia ⁽²⁾ growing very sparsely.

Prices.

The Director of the Zoötechnical station at Portici by a series of experiments, the result of which he published three years ago in the "Bollettino di Notizie Agrarie" of the Italian Ministry of Agriculture &c., ⁽³⁾, proves the great value of the carob, a fact already well known, as a food for horses and fattening cattle and milch cows.

In comparing the pecuniary value of the nourishing substances of this product with those of wheat he mentions the prices fixed by Settegast on the basis of analyses, as follows:—

Mean price of wheat per 100 kilograms.	Mean price of carobs.
Francs. 13.75—17.50	Francs. 8.5
" 18.75—21.25	" 10.78
" 22.50—25.0	" 13.43

Afterwards, taking into consideration the estimates made by Wolff in money per 100 kilogramms of the various digestible substances and comparing these estimates with the analyses of carobs made by different chemists he finds that according to the analysis made

By Wolff, 100 kilos of carobs have a value of francs	...	11.33
" Kühn "	"	11.21
" Muntz "	"	11.57
" Gohren and Settegast "	"	11.62
" Simonetti "	"	10.67
" Iosa "	"	11.24
Average	...	11.27

The price of carobs in Cyprus in 1854 (*) appears to have been higher than this average.

At the present time carobs are sold by the Cypriot grower to the merchant at from 8/- to 15/- per Aleppo cantar, that is, at 4.39 to 8.22 francs per 100 kilogrammes, according to the demand in the market and the quantity of the crop. However, it is to be noted that the tithe (1/- per cantar) is paid by the merchant on exportation.

The average value of the carobs per Aleppo cantar was according to the declarations of the merchants, on exportation :

in	1894	...	...	...	10/9½ d.
"	1895	...	...	...	7/10 "
"	1896	...	...	...	9/7 "
"	1897	...	...	...	11/1 "
"	1898	...	...	...	13/3 "
Five years' average	...	...	...	...	10/6

(1) The Agricultural Journal of the Cape of Good Hope. 1899; page 887.

(2) The Agricultural Gazette of New South Wales. 1897, page 493.

(3) No. 2 January, 1897, page 29—48.

(*) Gaudry. Recherches Scientifiques en Orient. page 89.

In the English markets Cyprus carobs are usually paid for at 1s. or 2s. per ton more than those of Portugal. Of course, the prices offered there also depend on the offer and demand and the quality of the crop.

The average of the prices at Syracuse, the greatest market of this product in Italy, was in 1892, frs. 10·71 per 100 kilos, (†).

1893	„	8·70	„
1894	„	7·25	„
1895	„	7·92	„
1896	„	6·62	„

Average 8·24

The average wholesale price of 8 to 10 fcs. per 100 kilogr. is that which carobs obtain in Tunis also (‡).

Atmospheric Influences on the crop.

Early cold winds coming on suddenly in autumn may damage the flower or fruit, as was the case in Cyprus in 1898.

The crop may also suffer damage by frost in January and sometimes in February, by hail in March and April, and by hot and dry winds in May and June. In these cases a great diminution in the crop may occur.

Parasites.

On the trunk and branches of Carob-trees, especially of old ones, two Polypori develop. (*Polyporus ignarius* and *P. sulphureus*, var. *Ceratoniae*). These I have met in Greece and they have also been observed in Italy (¹).

The fruit and leaves of the Carob-tree, especially when it grows in comparatively damp and not freely aired places, are attacked by a kind of mildew which Comes, having before him Italian samples, determined as *Oidium Ceratoniae* (²) and E. Salmon, having in view samples from Cyprus, as *Erysiphe communis*.

I have often met on the Carob-tree in Greece the *Aspidiotus Ceratoniae* (³), which is also to be met with on the Carob-tree in Cyprus, Southern France (⁴) and Spain (⁵).

Marchal (⁶) mentions the scale *Guerina Serratulae* as attacking the Carob-tree in Algeria.

(†) Grimaldi Alimentazione con carrube, page 3.

(‡) La "Caroube" (1898) Publication de la Société Franco-Algérienne, page 28.

(¹) Comes. Crittogame parassite delle piante agrarie, page 193 and 199.

(²) Grimaldi. Come fare fruttificare abbondantemente il carrubio, page 16 See also "Bulletin des Séances de la Société Nationale d'Agriculture de France." 1886, page 139.

(³) "Helleniki Georgia." 1895, page 27.

(⁴) Signoret. Essai sur les Cochenilles, page 92.

(⁵) Targioni-Tozzetti. Stazione Entomologica. Relazione 1879—82, page 384.

(⁶) Sur les insectes nuisibles de Tunisie et d'Algérie. 1896, page 4.

I have met with two new scales in Cyprus which often attack the Carob-tree with intensity and are accompanied by smut. These scales are the *Lecanium Ceratoniae* and the *Mytilaspis Ceratoniae* ⁽¹⁾. But the *Aonidia Aurantii* is also often to be met with in the Island on this tree.

The Carob-tree sometimes is also attacked in Cyprus by a leaping plant-louse (*Psylla Ceratoniae*?) which sucks in May and June the juice of the fruit when it is not mature yet.

The good results of thorough pruning and spraying with a solution of soap simply or with soap and petroleum against lice and scales of trees are well known.

But the disease which must be considered as the most injurious to the Carob-tree in Cyprus is that which causes the stopping of the development of the fruit and spreads periodically with intensity. This disease was noticed for the first time some 30 years ago. The cause of it was ascertained by me in 1899.

A very small insect which has not yet been determined but which may be in every probability a kind of *Cecidomyia*, lays its eggs in the autumn on the fruit which is then still very young. The larvae coming forth from these eggs get into the fruit (1 to 4 in each fruit) and commence to feed on its juice. The fruit which is thus attacked swells, ceases to increase in length and either remains short or gets dry on the tree before it ripens.

The late commencement of rains in autumn assists the development of this disease. It appears that early and comparatively abundant rains exterminate or decimate this pest.

I do not see any other practical remedy against this scourge except only the collection and destruction of the attacked fruit while it is still young.

Dry carobs, as all other dry fruits, have special enemies. In store they are attacked more or less in Cyprus also by the worm of a microlepidopterous insect (*Myelois Ceratoniae*). The carobs attacked by this insect are those which are known in the trade as *wormy*.

The numerous rats (*Mus Alexandrinus*), which are to be met with become a real scourge to the Carob-tree in certain areas in the Island. From the month of June till autumn they attack especially the most thriving trees, gnawing the bark of the most robust branches, which ultimately dry up.

The evil can be prevented provided that the owner of the attacked trees is diligent and persistent in the application of the proper means.

These rats, as a rule, make their nests in the cavities of the trunks of old trees and in the thickets around Carob-groves. So that if the hollows of these trees are filled up and the shrubs near them uprooted the rats would be got rid of.

(1) Bulletin de la Société Entomologique de France, 1895, page 277,

An effective means against the rat is also the use of traps and poisons. However, the use of the latter should be made with very great care so that domestic animals grazing in the Carob-groves and the birds which are so few in Cyprus, should not be poisoned.

The best means of using poison is to put the bait within earthen or tin pipes of an interior diameter of not more than two inches and to place them on the tree.

Some three years ago I tried the use of a special virus for transmitting a contagious disease to rats, but the results given were not those I anticipated.

Diseases caused from the nature of the ground.

In moist and rich soils, the Carob-tree is sometimes attacked by yellows which is called by the Italians *Gialumme* or *Seccume*. The symptoms of this disease are change in colour and falling of the leaves and barrenness of the tree. The evil lies in the roots, which are attacked by a root-destroying mould (*Dematophora necatrix*) which develops in damp places and becomes destructive to all fruit-trees.

The digging of the earth round the tree, the removal of the roots which are most attacked, the addition of a good quantity of ashes and lime and the draining of the soil may possibly prevent the decay of a Carob-tree thus attacked.

Finally, in very dry and sterile soils Carob-trees are sometimes to be met with, the fruit-eyes of which on account of want of sap cease to develop, become hard, and take the shape of knots more or less hard. This disease is called by the Italians *Rugga*, and is cured by thoroughly pruning the tree attacked and by manuring and digging deep the soil under it.

NOTES.

This treatise was published in Greek for the first time in the “Ἑλληνικὴ Γεωργία” of 1894 (page 573 and 601) and 1895 (page 23) and afterwards with additions and alterations in July, 1900. The present translation into English is made from this last edition.

Since the publication of the Greek edition of 1900, some fresh observations and enquiries have been made on the subject, which I have thought it best to insert separately here, with a reference to the page to which they relate.

Several of these additions are due to the excellent work on the Carob-tree of Dr. Francesco Castro, of Scicli (Sicily) published during the present year (*) and kindly sent to me by the author; in his work he has been good enough to refer repeatedly to my treatise of 1894—95 on the same subject.

(Page 3). *Seedra*. Mr. R. L. N. Michell in his “Egyptian Calendar” (London, 1900, page 110), in making mention of this shrub under the names commonly used in Egypt “*Nekk*” or “*Sidr*” (*Zizyphus Lotus*) says that “the fruit has a pleasant, rather acid taste, and is much appreciated by the Egyptians. A decoction of the bark is said to promote the healing of wounds (Redwood’s Suppl. to Pharmac). Egyptians sometimes use the powdered leaves as soap.”

(Page 4). *Introduction of the Carob-tree into Italy through Greece*. Another proof of this is that, in certain parts of Italy, according to Dr. Castro, the Carob-tree is commonly called *Carate*, a word which certainly has its derivation from the Greek *Κεράριον*.

(Page 5). *The Arabic name Charrub* according to Dr. Castro has probably the same origin as *Khirath* which is also used by Arabs especially when referring to the seed of the Carob; and *Khirath*, he says, has a great resemblance to the Greek root *Κερα*.

(Page 6). *Partly bipinnate leaves* I lately found on a young wild Carob-tree grown from seed in the yard of a house at Limassol. Such leaves are very rare, and so are also the unequally pinnate leaves.

(Page 8). *A monoœcious variety* also seems to exist in Spain. It is called *Flor y Garoffa* (Dr. Castro).

(Page. 8). *Hermaphrodite flowers, with fully developed stamens*. I have seen many of these during this year’s flowering on fruit-bearing Carob-trees in Tílliria and the District of Limassol.

(Page 9). *Opinion on the sexuality of the flowers*. My present opinion on the sexuality of flowers of the Carob-tree is not inserted in my treatise of 1894—95 on this tree, because I formed this opinion on observations made during the years 1898 and 1899. In perusing however the excellent work of Dr. Castro I see now for the first time that I have not the priority in the matter, for Prof. Heckel made similar observations ten years ago, and these were published in 1892 in the

(*) Il Carrubo—l’albero, la sua cultura e la sua utilità. Modica, 1901.

"*Répertoire de Pharmacie*" of Paris. He admits the self fertilisation of the flowers of the fruit-producing Carob-tree and he also accepts that the flowers of this tree are of a special hermaphrodite form which he calls *brachistemone*, viz.: with stamens reduced to the anther only. Dr. Castro does not agree with this theory.

(Page 14). *Cypriot variety in Italy*. Dr. Castro mentions among other varieties of the Carob-tree in Italy one which in Scicli is named *Giubiliana* and in Modica *Cipriana*. May it not be that it is a descendant of a Cypriot Carob-tree?

(Page 19). *Multiplication by sowing in the ground* has extensively been carried on in Ayios Theodoros and Leucara for some time past. The farmers of Leucara during the month of September or October place pieces of carobs (usually wild, for these cost nothing) with their seeds in a basket and water them regularly until the seeds swell and the perisperm breaks and leaves the rootlet of the plantule to appear. From 3 to 5 of these seeds (which are called there *Coccophyte*) are then placed in each spot of the field to be planted.

(Page 20). *Multiplication by sowing in pots*. Since the establishment of the nursery gardens at Nicosia, Larnaca and Contea (and lately at Limassol) large numbers of carob-seedlings are raised in pots and sold to the farmers, mostly of the Mesaoria. During the year 1900—1901 there have been issued from these three nurseries about 12,000 seed-grown carob plants.

(Page 21). *Diameter of the head of large Carob-trees*. The head of a large Carob-tree at Yaloussa (Carpas) is about 40 feet in diameter, covering a space of 1,255 square feet. The head of another large Carob-tree at Vatili (Mesaoria) is 43 feet in diameter, and covers a space of 1,450 square feet.

(Page 22). *Injury of grafts*. Grafts of Carob-trees in Cyprus are sometimes injured by the ants, which suck the sap and prevent the healing of the graft. I have advised the painting of the part where the graft has been made with a thick solution of soap; to which a very small quantity of petroleum has been added. This treatment where tried has proved very efficacious; it keeps off the ants and also a kind of fly which deposits its eggs on newly made grafts.

(Page 29). *Quantities of Carobs exported from Cyprus*.

In 1899	Haleppo Cantars	107,377
" 1890	" "	140,644

Cypriot weights and measures mentioned in the text.

Oke equal to $2\frac{1}{2}$ lbs. 40 okes = one cwt.

Aleppo cantar = 180 okes.

Donoum = $\frac{1}{3}$ of an Acre or 14,520 sq. feet.

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